STABILIZER BAR AND BUSHING ASSEMBLY

DESCRIPTION

BACKGROUND OF THE INVENTION

[Para 1] 1. Field of the Invention

[Para 2] The present invention relates to a stabilizer bar assembly for a vehicle that includes a stabilizer bar and at least one bushing used to attach the stabilizer bar to the vehicle to limit lateral movement.

[Para 3] 2. Background Art

[Para 4] Vehicles such as cars, trucks, sport utility vehicles and the like are provided with suspension systems. Vehicle suspension systems support a vehicle on its axles to provide a comfortable ride and improve the handling characteristics of the vehicle. Vehicle suspension systems may include shock absorbers, springs, control arms and stabilizer bars. A stabilizer bar that connects an axle to the frame of a vehicle may be provided for the purpose of limiting or reducing sway. Stabilizer bars also function to reduce transverse jounce or rebound travel from one side of the vehicle to the other. With a stabilizer bar, if one side of a vehicle moves in an upward direction the other side is also pulled up. This facilitates maintaining the vehicle in a substantially level orientation. The stabilizer bar may be connected to the axle by means of a control arm and a link. The stabilizer bar may be connected to the frame of the vehicle by means of bushings.

[Para 5] A recurring problem that confronts vehicle suspension design engineers is that there is a limited amount of space between a vehicle frame and axle to fit suspension components. To compound this problem, the design engineer needs to allow for normal suspension part movement without encountering interference with other chassis components, tires, brakes, and the like. Stabilizer bars tend to be subjected to lateral loading which can lead to lateral movement of the stabilizer bar. Potential lateral movement must be factored into suspension designs. One approach to limiting lateral movement of a stabilizer bar is to add lateral restraint members adjacent to bushings that encircle the stabilizer bar and are secured to the frame by means of brackets. Generally two bushings are preassembled to a straight section of the stabilizer bar and a collar is secured to the stabilizer bar on the straight section next to the bushing. One collar is assembled adjacent to one of the bushings to limit lateral movement to the right while another collar is assembled adjacent to a bushing to limit left hand lateral movement. The collars and bushings are normally preassembled to the stabilizer bar before they are assembled to the vehicle. Vehicle build tolerances require that some space be provided between the collars and the bushings. Typically, a gap of between 6 and 10 millimeters is required to accommodate vehicle tolerance build-up. This gap permits some limited lateral movement without encountering resistance from the bushing. This concept of providing collars adjacent to the bushings is disclosed in U.S. Patent No. 5,352,055.

[Para 6] Another approach to limiting lateral movement of a stabilizer bar was developed for the 1989 Thunderbird that had upset portions formed on the stabilizer bar and also included bushings that were assembled to the stabilizer bar beside the upset portions. Each upset portion restrained lateral movement in one direction when engaged by its associated bushing. It is believed that during assembly spacing was provided between the bushing and the upset portion to accommodate vehicle assembly tolerances. Such gaps allow some lateral travel of the stabilizer bar without resistance from the bushing.

[Para 7] The present invention is directed to solving the above problems and improving upon prior vehicle suspension system stabilizer bar assemblies. A stabilizer bar assembly is provided that immediately resists lateral movement of the stabilizer bar. In addition, the present invention minimizes the number of parts and potentially reduces vehicle weight, as summarized below.

SUMMARY OF THE INVENTION

[Para 8] According to one aspect of the present invention, a stabilizer bar assembly is provided for a vehicle having an axle assembly and a suspension system for supporting the vehicle on the axle assembly. The stabilizer bar assembly comprises a stabilizer bar having right and left ends that are operatively connected to the axle assembly at spaced locations. The stabilizer bar has an annulus intermediate its ends. A first bushing and a second bushing are provided that each have an inner surface that contacts the stabilizer bar. The bushings have a groove for receiving at least a portion of the annulus and contacting opposite sides of the annulus. A first and second bracket are provided that each contact an outer surface of one of the bushings to secure the first and second bushings and the stabilizer bar to the vehicle at spaced locations.

[Para 9] According to another aspect of the present invention, a stabilizer bushing assembly and a stabilizer bar are provided in combination. The stabilizer bar has a radially outwardly extending protrusion. The bushing assembly includes a bushing having an inner surface that is adapted to engage a stabilizer bar and an outer surface that has a first surface feature. The inner surface of the bushing defines a concavity that has right and left sides that are adapted to engage the protrusion of the stabilizer bar to resist lateral movement of the stabilizer bar relative to the bushing. A bracket engages the outer surface of the bushing and has a second surface feature

that engages the first surface feature of the bushing to resist lateral movement of the bushing relative to the bracket.

[Para 10] According to other aspects of the invention, the protrusion or annulus may be a ring integrally formed on the stabilizer bar. The integrally formed stabilizer bar may be formed by heating the stabilizer bar and upsetting the bar in a forming die. Alternatively, the protrusion may be a separately formed ring that is secured onto the stabilizer bar in an assembly operation. The stabilizer bar may be a solid bar or a hollow tubular member.

[Para 11] According to other aspects of the invention, the bushing may have a cross-section that defines a groove to include first and second walls that extend radially outwardly from the inner surface of the bushing so that the first and second walls engage the opposite sides of the annulus or protrusion. Alternatively, the bushing may have a cross-section that defines a groove to include a curved concave wall that extends between two spaced portions of the inner surface of the bushing. The curved concave wall contacts opposite sides of the annulus or protrusion.

[Para 12] According to still further aspects of the invention, a rib may be formed on an outer surface of the bushing and the bracket may have a receptacle portion for receiving the rib. Lateral loads applied to the groove by the annulus are resisted by the bushing and transferred through the rib to the bracket.

[Para 13] These and other aspects of the present invention will be better understood in view of the attached drawings and in light of the detailed description of several embodiments of the invention that is provided below.

BRIEF DESCRIPTION OF THE DRAWINGS

[Para 14] Figure 1 is a fragmentary perspective view of a front vehicle suspension having a stabilizer bar assembly made according to the present invention;

[Para 15] Figure 2 is an exploded fragmentary perspective view of a stabilizer bar, a bushing and a bracket made according to the present invention;

[Para 16] Figure 3 is a fragmentary perspective view of the stabilizer bar showing the bushing assembled to an annular ring on the stabilizer bar;

[Para 17] Figure 4 is a fragmentary exploded perspective view of the stabilizer bar and a frame rail with the bushing assembled to the stabilizer bar and the bracket shown oriented for assembly to the frame member with fasteners;

[Para 18] Figure 5 is a cross-sectional view of a bushing assembled to the stabilizer bar;

[Para 19] Figure 6 is a fragmentary cross-sectional view of an alternative embodiment of a stabilizer bar bushing and bracket;

[Para 20] Figure 7 is an exploded perspective view of a stabilizer bar having a spherical ring formed thereon with a bushing and bracket for securing the stabilizer bar to a frame member; and

[Para 21] Figure 8 is a fragmentary cross-sectional view of the stabilizer bar bushing and bracket shown in Figure 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[Para 22] Referring to Figure 1, a suspension system 10 for one axle of the vehicle is shown. This application focuses on the stabilizer bar assembly 12 of a suspension system 10. The stabilizer bar assembly 12 has a stabilizer bar 14 that connects a right wheel assembly 16 and a left wheel assembly 18 for the purpose of limiting sway and reducing transverse jounce from one side of the vehicle to the other. Each wheel assembly has a wheel hub 20 to which a vehicle tire (not shown) is attached. A shock absorber 22 and spring 24 connect the wheels to the frame and

provide a comfortable ride. An "L" or "A" control arm 26 and an upper control arm 28 connect the wheel assembly to the vehicle frame. The vehicle frame includes a right frame rail 30 and a left frame rail 32. A bushing assembly 34 is secured to each of the left and right frame rails 30 and 32 and form part of the stabilizer bar assembly 12. The bushing assemblies 34 are secured to the stabilizer bar 14 and will be more fully described below.

[Para 23] Referring to Figures 2-4, one embodiment of a bushing assembly 34 is described in greater detail. The bushing assembly 34 includes a bracket 36 and a bushing 38. The bushing 38 may be formed of rubber, elastomeric urethane, or the like. The bushing 38 encircles the stabilizer bar 14. One of the bushings also captures an annular ring 40 that is formed on or assembled to the stabilizer bar 14.

[Para 24] The annular ring 40 may be formed by heating the stabilizer bar and upsetting the bar in a forming die. Depending upon the application, only one annular ring 40 may be formed on the stabilizer bar 14. Stabilizer bars may be either solid or tubular. An annular ring 40 may be assembled to the tubular stabilizer bar by crimping or an equivalent assembly technique for tubular stabilizer bars.

[Para 25] The bushing 38 may be a flat base portion 42 and a generally U-shaped outer surface 44. Alternatively, the bushing may be cylindrical or have a different shape. The bushing 38 has a circular inner diameter 46 that includes an annular groove 48. A rib 50 is formed on the outer surface 44 of the bushing 38. A split 52 is provided in the bushing 38 that may extend in a generally radial direction from the exterior of the bushing 38 to the circular inner diameter 46. The bushing 38 is assembled to the stabilizer bar 14 by separating the bushing 38 at the split 52 and sliding the stabilizer bar 14 through the split 52. The bushing 38 is assembled to the stabilizer bar 14 with the annular ring 40 being captured, or restrained between, a right side 54 and a left side 56 of the annular groove 48. The right side 54 and left sides 54 and 56 function to center the annular ring 40 within the bushing 38 at

assembly and during vehicle operation. Forces applied to the stabilizer bar 14 driving it toward the right or left are resisted by one of the sides of the annular groove 48.

[Para 26] The bracket 36 includes a receptacle portion 58 that receives the rib 50 formed on the outer surface 44 of the bushing 38. The receptacle portion 58 has a right inner face 60 and a left inner face 62 that engage the sides of the rib 50. The rib 50 centers the bushing 38 relative to the bracket 36 and retains bushing 38 within the bracket 36. The bracket 36 has flanges 64 with holes 66 for receiving bolts 70 or other fasteners.

[Para 27] Referring to Figure 5, a bushing assembly 34 is shown attached to a stabilizer bar 14 at a point on the stabilizer bar 14 in such a way that it captures an annular ring 40 within the bushing 38.

[Para 28] Referring to Figure 6, a bushing assembly 34 is shown secured to a stabilizer bar 14 on a portion of the stabilizer bar 14 that does not have an annular ring. The bushing assembled in this manner retains the stabilizer 14, but does not function to center the stabilizer bar except to the extent that the circular inner diameter 46 of the bushing 38 exerts a frictional grip on the stabilizer bar 14.

[Para 29] Referring to both Figures 5 and 6, the stabilizer bar 14 may be conveniently secured to right and left frame rail 30 and 32 to be manufactured without requiring a gap or clearance to accommodate tolerance stack-up. The bushing assembly 34 of Figure 5 may securely engage the annular ring 40 and center the stabilizer bar relative to frame rail 30. The bushing shown in Figure 6 may be assembled to the stabilizer bar 14 in a range of locations along the stabilizer bar so that the bolt 68 securing the bushing assembly 34 to the left frame rail 32 will properly align. At least one portion of the stabilizer 14 is provided with annular ring 40. The bushing assembly 34 is usable in either mode without requiring the use of two different bushing assemblies 34. There is no need to provide for tolerance stack-up between right and left frame rails 30 and 32. Assembly of the stabilizer bar assembly

12 to the vehicle is unaffected even if the frame rails 30 and 32 are slightly wider apart or narrower than the exact vehicle specifications. The centering function is provided primarily by one bushing assembly 34, while the other bushing assembly 34 still functions to reduce sway and transverse jounce. Since no clearance must be allowed for assembly purposes, improved clearances in the vehicle package may be achieved.

[Para 30] Referring to Figures 7 and 8, another alternative embodiment is disclosed that may be referred to as a spherical bushing assembly 90. The spherical bushing assembly 90 engages a spherical upset portion, a surface feature, 92 that is formed on a stabilizer bar 94. A bushing 96 is provided with a concave portion 98 that has a right concave side 100 and a left concave side 102 that engage opposite sides of the spherical surface feature 92. The spherical surface feature 92 is centered within the bushing 96 by the concave groove 98. Right and left concave sides 100 and 102 resist right and left side-to-side displacement of the stabilizer bar 94. A convex rib 104 is provided on the outer surface of the bushing 96 or may be formed when the bushing 96 is received by the concave central portion 106 of the bracket 108. The bracket 108 is assembled to the frame rail 30 by a bolt 110 or other fastener.

[Para 31] The embodiment of Figures 7-8 is assembled to the frame of the vehicle as previously described with reference to Figures 2-6. Only one spherical surface feature 92 need be provided on the stabilizer bar to accommodate vehicle build tolerances as previously described with reference to the bushing assembly described with reference to Figures 2-5.

[Para 32] While the best mode for carrying out the invention has been described in detail, those familiar with the art to which this invention relates will recognize various alternative designs and embodiments for practicing the invention as defined by the following claims.